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Middle Paleozoic impact event in the southwest of the East European Platform

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Abstract

A zone with high remanent magnetization and magnetic susceptibility has been identified at the boundary between Lower Devonian gray- and red-colored deposits in the basin of the Dniester River in the southwest of Ukraine (in the southwest of the East European Platform). The microparticles of native iron and nickel and iron–nickel intermetallic compounds found here might be markers of an impact event in the Lochkovian (~415 Ma). Electron microscope examination and probe microanalysis of the chemical composition, morphology, structures, and textures of specific microobjects showed that they are the product of melting of meteoritic substance and target rocks caused by an impact explosion. Explosive dispersion and deposition of microparticles on the Earth's surface result in a rapid differentiation of their substance. The obtained data can be used as evidence of a reference impact event during the fall of an iron-stone meteorite, and a characteristic set of minerals and geochemical parameters can help to identify catastrophic events in the geologic history.

Keywords: Lochkovian; impact explosion; differentiation processes; metallic microparticles; chemical composition; East European Platform

Introduction

Terrestrial rocks often contain products of impact processes (impactites) caused by the fall of large meteorites (Akulov et al., 2014; Pechersky et al., 2012, 2015a,b). Microparticles (mostly metallic) up to 1 mm in size are widely dispersed, because they can be transferred to hundreds and thousands of kilometers from the place of fall of cosmic bodies. The typomorphic compositional and structural specifics and the formation conditions of such microparticles, required for their identification, have been poorly studied (Sungatullin et al., 2016). This restricts their use in stratigraphy (Sungatullin et al., 2014, 2017) and for the elucidation of the causes of catastrophic events in geologic objects (Sungatullin et al., 2015a,b,c).

An impact on terrestrial rocks leads to their acquisition of additional natural remanent magnetization and to changes in their mineral composition (Drabkina et al., 2011). As shown by the example of the Kara astrobleme (Sergienko et al., 2010), the natural remanent magnetization of impactites (suevites) is due to sulfides, native iron, native nickel, magnetite grains and microspheres, and particles with titanomagnetite exsolution structures. The diversity of magnetic minerals points to the natural thermoremanent magnetization of impactites and the same ages of primary magnetization and the impact event. Fel'dman et al. (1988) showed that all iron minerals in the Kara astrobleme crystallized from an impact melt enriched in nickel because of the impact meteoritic substance. This work was aimed at studying the magnetic parameters and chemical and mineralogical specifics of impact objects and refining the processes of substance differentiation. This information is necessary for a more objective identification of cosmic catastrophes in the geologic records.

The object and methods of study

The transitional Lower–Middle Paleozoic section of Podolia is located in the basin of the Dniester River in the

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